

APPENDIX C

Standard Operating Procedures for Groundwater Sampling

C. STANDARD OPERATING PROCEDURES (SOPs) FOR GROUNDWATER SAMPLING

This appendix describes the SOPs for all of the tasks associated with sampling the monitor wells and the KMCC seep within the offsite downgradient area. All sampling sites will be documented during the field reconnaissance and sampling with photographs and field notes; slight modifications to these SOPs may be deemed necessary based on the results of the field reconnaissance. The sampling tasks described in this appendix include the following activities:

- Organization of Sampling Equipment and Sampling Forms;
- Monitor Well Purging and Stabilization of Water Quality;
- Groundwater Sample Collection;
- Sample Handling and Delivery to the Laboratory; and
- Chain-of-Custody Procedures.

C.1 Organization of Sampling Equipment and Sampling Forms

Prior to the start of sampling activities, the sampling personnel will gather the sampling equipment, containers and forms. Equivalent equipment may be used, where applicable. Prior to use, the equipment will be clean and operational and will consist of the following:

- A submersible Grundfos® Rediflow pump (or equivalent) of appropriate diameter for each monitor well.
- Sufficient tubing of appropriate material, diameter and length to be dedicated to each monitor well.
- A Horiba U-10 meter fitted with a flow-through cell to measure pH, specific conductance, temperature, turbidity and dissolved oxygen (or equivalent).
- Calibrated containers and drums for directing and collecting water downstream of the flow-through cell, to measure pumping rate, total discharge and contain purge water for appropriate waste management activities.

The groundwater sampling form will be filled out and signed by the sampling personnel during sampling activities.

C.2 Monitor Well Purging Activities

The purpose of well purging is to bring water from the aquifer into the well casing prior to sampling because the water within the well casing may not be representative of the surrounding aquifer. Standing water in a monitor well may not be representative of nearby groundwater because a monitor well is generally vented into the atmosphere. Contact with the atmosphere allows the influx of atmospheric oxygen, changing the reduction/oxidation (redox) potential of groundwater, and hence, the solubility of certain dissolved species. Purging is performed to remove the standing water prior to sample collection. Purging induces stresses that can suspend small particles and draw them into the monitor well. In addition purging may possibly strip volatile organic compounds (VOCs) from the water. If the pump flow rate is reduced, these stresses are reduced. To address the concern over sample turbidity and stripping of VOCs, a low-flow sampling procedure will be used to minimize the stresses that might suspend fine particles.

Water purged from the groundwater wells will be monitored for changes in temperature, pH, specific conductance, turbidity, and dissolved oxygen with a Horiba U-10 meter (or equivalent). Temperature, pH, specific conductance, turbidity and dissolved oxygen are referred to as the water quality parameters in this document.

In preparation for purging the groundwater wells, the purging and monitoring equipment will be organized and confirmed operational. A submersible Grundfos® Redi-Flo pump (or equivalent) will be lowered into the well and suspended in the upper portion of the screen interval. A cable will be attached to the pump and will be used to lower the pump into the monitor wells. The cable will be measured and marked with a segment of tape to indicate the length of the cable that can be lowered into the well so that the intake of the pump is not lowered past the designated depth. The cable will be attached to the pump and to the well head, so that the location of the pump cannot shift during purging and sampling.

Appropriate diameter tubing will be used for the discharge tubing. The dedicated tubing will be connected to the pump at the pump outlet (barbed fitting) with a hose clamp. The discharge from the bladder pump will be secured to the flow-through cell fitted to the Horiba U-10 water quality parameter meter. The discharge from the flow through cell will be connected to a calibrated container to contain waste water. A two way stainless or Teflon valve will be located in the discharge tube immediately upstream (i.e.,

in front) of the flow-through cell for sampling purposes. At the beginning of purging, the flow rate will be adjusted using the variable speed of the pump to generate flow and drawdown as outlined below. If the drawdown exceeds the target drawdown, the flow rate will be reduced accordingly.

Well Diameter	Target Flow Rate	Target Drawdown
2-inch	1 L/min	≤ 1.0 foot
4-inch	1 L/min	≤ 1.0 foot
5-inch	1 L/min	≤ 1.0 foot

The volume of purge water and duration of this first stage of purging will then be recorded. Purging will continue with measurements of water quality parameters every 5-10 minutes, until water quality parameters stabilize. Water quality parameters that will be measured are pH, specific conductance, temperature, dissolved oxygen, and turbidity. Water quality parameters will be measured in the field according to the procedures outlined below:

1. During the purging process, groundwater will fill the flow-through cell. The cell should be adjusted until air bubbles are removed. The fittings will be adjusted to be essentially leak-free. The Horiba U-10 probe will be located in the flow-through-cell, and water quality parameters will be collected as water flows through the cell.
2. The subsequent readings will be documented on the groundwater sampling field sheets. Measurements will be repeated every 5-10 minutes and at least five sets of measurements will be completed for every well. Visual observations of the clarity and color of the pump discharge water also will be recorded. In addition, water levels in the wells will be periodically measured during purging. These successive field parameter measurements will be used to determine when purging is sufficient and sample collection may proceed. In general, purging will continue until all field parameters and visual observations show no significant fluctuations or trends (increasing or decreasing over time). The stabilization of water quality parameters will be defined as no consistent increasing or decreasing trend among the previous five readings and/or changes among the previous three readings of no more than:
 - ± 0.1 unit for pH,
 - $\pm 3\%$ for specific conductance (%),
 - ± 0.2 °C for temperature,

- $\pm 10\%$ for turbidity (%), and
 - $\pm 5\%$ for dissolved oxygen (%).
3. The Horiba U-10 water parameter meter (or equivalent) will be used to monitor the development of the wells. The Horiba U-10 meter (or equivalent) will be calibrated at field temperature a minimum of twice a day: once prior to commencing field work and at the end of day after sampling has been completed. Instrument calibration will be conducted in accordance with manufacturer's instructions. The Horiba instrument will also will be recalibrated at anytime during sampling activities if inconsistent readings are suspected.

The purging goal will be to achieve turbidity below 5 NTU and stabilization of the water quality parameters. However, this may not be possible in all wells. The total volume purged will be at least 3 well volumes. The total volume purged and the time will be recorded at the end of each stage of purging. The volume of purge water removed from each well will be measured using a calibrated container. Immediately following purging, a sample of groundwater will be collected according to the procedures described in Section 4.4.2. Groundwater purge water will be stored in accordance with the Waste Management Plan presented in Section 4.4.5.

C.3 Groundwater Sample Collection

This section describes the procedures to be followed for the collection of groundwater samples. These procedures will be implemented immediately following the presampling activities described. The activities for groundwater sample collection include: (1) sample withdrawal; (2) sample handling, and (3) post sampling confirmation of water quality parameter measurements. The procedures for sampling the KMCC seep will be finalized (based on the results of the field reconnaissance)

The groundwater sample will be collected immediately following the purging activities described above. The samples will be collected using the submersible Grundfos® Redi-Flo pump (or equivalent) and the discharge tube used for purging. The sample will be collected from a sampling valve or port located immediately upstream of the flowthrough cell. The submersible Grundfos® Redi-Flo pump (or equivalent) will be operated at a discharge rate of approximately 100 ml/minute for VOC samples. The discharge tubing will be cleared at a low pumping rate before samples are collected. The volume of water to be cleared will be calculated with the following equation:

$$V = 0.041 \times d^2 \times H$$

Where:

- V = volume of water in the length of tube located between the pump and the sampling port, in gallons;
- d = inside diameter of the tube, in inches;
- H = length of tubing between the pump and sampling port, in feet.

(Note that a conversion to liters is: $V/0.264$ = volume in liters.)

In addition, samples will be collected in accordance with the other following guidelines:

- Gloves worn during purging will be discarded and replaced with clean gloves for sampling;
- Sample containers will not be opened until immediately prior to filling;
- The insides of sample containers will not be touched, including with clean gloves;
- Chain-of-custody forms will be maintained throughout the sample collection;
- Samples will be collected and containerized in accordance with the volatility of the target analytes;
- Sampling containers will be filled slowly and with minimal aeration with the pump (see above);
- Sampling containers will be filled completely, but not overfilled, as this will result in the loss of preservative;
- Sampling containers will be filled as expeditiously as possible to minimize the time between filling the first sample container and the last; and
- Filled sample containers will be labeled, prepared for transport, and stored in an ice chest or cooler.

Samples collected for dissolved metals will be filtered using a Nalgene© in-line 0.45-µm filter or equivalent. Filtering will be performed by collecting about 500 mL in a clean plastic bottle and using a hand pump to pump the sample from this container through the in-line filter into the 500-mL sample container. Approximately 1/10 of a liter of water will be pumped through the filter and disposed of before sample collection. Alternatively, an inline filter will be attached directly to the tubing and filtered directly into the sample container.

Following sampling, the well will be retested for groundwater quality parameters (pH, specific conductivity, temperature turbidity, and dissolved oxygen). The retesting will serve as a measure of purge efficiency and as a check on the stability of the water samples over time. The retest will be conducted by pumping water through the flow-through cell, and the readings will be documented.

C.4 Sample Handling Procedures

C.4.1 Sample Identification

Samples will be identified using the well identification and the date. For example, the sample name PC-056-20060110 will represent the sample collected from well PC-056 on January 10, 2006. The well identification for trip, field and equipment blanks will be TB, FB, and EB respectively. Sample names for field duplicates will have a D immediately after the well identification.

C.4.2 Labels

Sample labels are accountability documents and are attached to a sample. The following information, as appropriate, will be included on the sample labels using waterproof, non-erasable ink:

- Project number;
- Sample identification;
- Date and time, (day/month/year);
- The initials of the sampler(s);
- Whether the sample is preserved or unpreserved; and
- The general types of analyses to be performed.

C.4.3 Chain-of-Custody Procedures

Chain-of-Custody procedures comprise the following elements: (1) maintaining custody of samples, and (2) documentation of the chain-of-custody. To document chain-of-custody, an accurate record must be maintained to trace the possession of each sample from the moment of collection through analysis and reporting. An example Chain-of-Custody Form is presented in Appendix C.

The field Chain-of-Custody Record is used to record the custody of all samples collected and maintained by investigators. All sample sets will be accompanied by a Chain-of-Custody Record. This Chain-of-Custody Record documents transfer of custody of samples from the sample custodian to another person, to the laboratory, or other organizational entities. The Chain-of-Custody Record also serves as a sample logging mechanism for the laboratory sample custodian. A separate Chain-of-Custody Record will be used for each final destination or laboratory used during the investigation. The following rules apply to Chain-of-Custody Records:

- All information must be supplied in the indicated spaces to complete the field Chain-of-Custody Record.
- All samplers and sampling team leaders (if applicable) must sign in the designated signature block.
- One sample should be entered on each line and not be split among multiple lines.
- The total number of sample containers for each sample must be listed in the appropriate column. Required analyses should be circled or entered in the appropriate location as indicated on the Chain-of-Custody Record.
- The sample custodian and subsequent transferee(s) should document the transfer of the samples listed on the Chain-of-Custody Record. The person who originally relinquishes custody should be the sample custodian. Both the person relinquishing the samples and the person receiving them must sign the form. The date and time that this occurs should be documented in the proper space on the Chain-of-Custody Record.
- Usually, the last person receiving the samples should be the laboratory sample custodian or their designee(s).

The Chain-of-Custody Record is a serialized document. Once the Record is completed, it becomes an accountability document and will be maintained in the project file.

C.4.4 Sample Shipment

Prior to sampling, the sample containers will be stored properly in a cooler to reduce the potential for breakage, spillage, or label deterioration. Proper sample storage consists of “bubble wrap” around glass bottles or vials, sealable Zip-Lock®-type bags around sample containers, and packing material to occupy remaining voids.

Immediately following sampling, the samples will be stored in coolers with wet ice. The samples will continue to be stored in this manner until the samples are analyzed in the laboratory. The presence of solid ice within and the internal temperature of the cooler will be checked periodically in the field and recorded on daily field sheets. In addition, the presence of ice and the temperature of the samples will be measured and recorded upon receipt by the laboratory. On hot days, the field samplers will periodically monitor the cooler to remove melted ice and add ice, as needed, to maintain the acceptable volume of ice.

The coolers containing the groundwater sample containers will be delivered to the laboratory on the same day the samples are collected. The laboratory for this project will be Del Mar Analytical, Inc. in Las Vegas, Nevada. Fresh wet ice will be added as required. Each set of samples will be accompanied by a chain-of-custody form, which outlines the contents of the cooler. Information to be included on the chain-of-custody form is described in Section 4.4.3.3. The chain-of-custody form will be completed and signed by the sampler(s) before departing the monitoring point, but after the samples have been packed into the cooler containing ice. The completed chain-of-custody form then will be sealed in a Zip-Lock®-type bag and placed in the cooler. Whenever the cooler is exchanged from one person to the other (including couriers and laboratory personnel), the persons relinquishing and receiving the cooler will sign and date the chain-of-custody form. A custody seal will be placed on the front of the cooler and bear the signature of the collector and collection date. The laboratory receptionist will confirm the integrity of the signature upon receipt of the cooler.

C.5 Quality Assurance Procedures

Field QC samples will be collected and analyzed to assess the consistency and performance of the groundwater sampling activities. QC samples for this project will include field duplicates, MS/MSD, equipment rinsates when necessary, and trip blanks.

C.5.1 Trip Blanks

Trip blanks will be prepared by the laboratory in 40-milliliter (mL) vials with analyte-free water. The trip blanks will be carried into the field, stored, and shipped to the laboratory along with the water samples. One trip blank will be shipped with each cooler that contains samples to be analyzed for VOCs. Trip blanks are evaluated to determine whether VOC cross-contamination between samples has occurred during storage and transportation. Trip blanks apply only to volatile organics and must be free of headspace.

C.5.2 Field Blanks

Collection and analysis of field blanks are provided as QC checks on the integrity of sample collection and handling procedures. Prepare field blank samples by using deionized water and sample bottles randomly selected from the bottles prepared for environmental samples. Assign field blank samples unique sample numbers so as to not be identified by the laboratory as blank samples.

Collect and analyze one field blank each day that the environmental samples are collected. Analyze each field blank by using the same methods and procedures as those to be used for volatile organic compounds for the environmental sample.

C.5.3 Equipment Blanks

Collection and analysis of field equipment blanks are provided as QC checks on the integrity of equipment decontamination procedures. Prepare equipment rinsate samples by using deionized water and sample bottles randomly selected from the bottles prepared for environmental samples. Assign equipment rinsate samples unique sample numbers so as to not be identified by the laboratory as rinsate samples.

Collect and analyze one equipment rinsate blank for every day of sampling when using non-dedicated equipment to sample groundwater. Analyze these blanks for the same

sample compounds, elements, or parameters as those analyzed for the collected environmental samples.

C.5.4 Field Duplicates

Field duplicates are two samples (an original and a duplicate) of the same matrix, to the extent practicable, collected at the same time and location and using the same sampling techniques. Field duplicate samples are used to evaluate the precision of the overall sample collection and analysis process. Field duplicates will be collected at a frequency of 1 per 10 regular samples and will be analyzed for the full set of analyses used for the regular sample collected. Exact locations of duplicate samples and sample identifications will be recorded in the field logbook.

C.5.5 MS/MSD Samples

The laboratory will analyze an MS/MSD for every twenty samples analyzed or for every analytical batch prepared, whichever is more frequent. Field personnel will collect triple the amount or the volume of the sample matrix for the designated MS/MSD sample. The MS/MSD sample will be used to determine the precision of the sample preparation and analytical methods.

C.6 Decontamination Procedures

The purpose of decontamination is: (1) to eliminate the transfer of contaminants from one groundwater monitor well to another, and (2) to protect the health and safety of personnel who may come in contact with contaminated equipment. Decontamination procedures described in this section will be performed at the beginning of each day of field work, between each boring and monitor point, at the end of each day of field work, and whenever the equipment is suspected of having been contaminated.

A simple triple rinse system is utilized to decontaminate the pump and electrical lead between wells. The triple rinse system involves running the pump in cleaning tubes that contain three progressively cleaner grades of water. The following steps will be followed:

1. Remove the pump, electrical lead and dedicated tubing from the well.

2. Disconnect the dedicated PE tubing from the pump.
3. Place the pump and electrical lead into the Integrated Decon Sink and perform an initial rinse using a high-pressure washer.
4. Place the pump into the first cleaning tube or bucket containing approximately 5 gallons of a Liquinox / clean water solution. Run the pump within the solution for 2 minutes.
5. Place the pump into the second cleaning tube or bucket containing approximately 5 gallons of clean water. Run the pump within the water for 2 minutes.
6. Place the pump into the third cleaning tube or bucket containing approximately 5 gallons of clean water. Run the pump within the water for 2 minutes.
7. Finally, place the pump and electrical lead into the Integrated Decon Sink and perform a final rinse using a high-pressure washer.
8. Replace water and water solutions daily.